Laser Geodynamic Satellite Assembly Operation

LAGEOS Assembly Operation Plan

DR No. MA-05
DPD No. 296
Contract NAS 8-30658

October 1975

Prepared for:

George C. Marshall Space Flight Center
National Aeronautics and Space Administration
Marshall Space Flight Center, Alabama 35812

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Title: LAGEOS Assembly Operation Plan

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1. INTRODUCTION

The LAGEOS is the first in a series of satellites designed to investigate the discipline of earth and ocean dynamics. The program dedicated to this study is the Earth and Ocean Physics Applications Program (EOPAP). Its primary goals are to identify, develop and demonstrate relevant space techniques that will contribute significantly to close monitoring of plate and crustal motions, polar motion, earth rotation-rate variation, ocean-surface conditions and ocean circulation. The LAGEOS is concerned with the physical motions and distortions of the solid earth that are responsible for earthquakes, tidal waves, volcanic eruptions, mineral differentiation, mountain building, etc. Predictions of probable time. location and intensity of earthquakes could lead to enormous savings in lives and property. The LAGEOS will make available, for the foreseeable future, the capability for laser ranging of maximum accuracy.

The LAGEOS Assembly Operation is a 9-month effort devoted to the assembly, handling and shipping of the LAGEOS, to be performed by the Bendix Aerospace Systems Division, Ann Arbor, Michigan.

Assembly of the satellite will utilize the spherical structure (ball) that was manufactured for a Dynamic Balance test model and subsequently completed to the flight configuration by MSFC. Also, due to the long lead time for the raw material procurement, the cube corner retroreflectors (CCR's) are in process, on another MSFC contract, at Perkin-Elmer Corporation and are scheduled to be completed to support this assembly operation.

Bendix Aerospace has been responsible for development and verification of the LAGEOS design performance in a study effort devoted to thermal, optical and dynamic analyses and testing. The LAGEOS experience, as well as the extensive previous Bendix experience in the design, development and test of the three Apollo Laser Ranging Retroreflector (LRRR) experiments on the ALSEP program, will be utilized in this assembly operation effort.

2. OPERATION PLAN SUMMARY

The objectives of the LAGEOS Assembly Operation are to accomplish:

- Initial assembly of the LAGEOS satellite at the Bendix Aerospace facility.
- Providing of a shipping container for transporting the assembled LAGEOS satellite.
- Handling of the assembled LAGEOS satellite at GSFC during the LAGEOS optical testing.
- Handling of the assembled LAGEOS satellite and installation of flight fittings at the Western Test Range (WTR), prior to mating of the satellite with the launch vehicle separation adapter.
- Installation of test CCRs in LAGEOS, prior to dynamic tests at McDonnell-Douglas Astronautics Company-West (MDAC-W) facility, and subsequent removal at Bendix.

The scope of this plan is to describe the detail tasks required to accomplish these objectives. The plan also illustrates the interrelationship and sequence of these tasks in a flow diagram and identifies the task schedule to meet the contract schedule requirements. The quality assurance functions to be implemented for verification of the operation tasks, the documentation to be submitted in the course of the operation and the contract guidelines and constraints are also described in the plan.

3. ASSEMBLY OPERATION TASK DESCRIPTIONS

The LAGEOS Assembly Operation tasks are described, in detail, in this section. The guidelines and constraints which form the basis for these tasks are described in Appendix A, herein. Table 3-1 shows the relationship of these tasks to the Contract Scope of Work (Ref. A).

3.1 Satellite Initial Assembly

3.1.1 Generate satellite cleaning and assembly procedures, in the Bendix standard procedure format. These shall delineate the steps required to be followed and shall provide the means for documenting the accomplishment of the cleaning and assembly operations, including the identification and resolution of hardware and procedural discrepancies. Release the procedures, after NASA review and approval, and revise, as required, after procedure checkout in the training exercises.

3.1.2 Generate a training plan which describes the training exercises to be accomplished by the personnel who will be involved in the cleaning and assembly of the LAGEOS, including those responsible for quality control functions.

3.1.3 Conduct training exercises at Bendix for personnel, including quality control, who may be assigned to the cleaning and assembly operations of the LAGEOS. These exercises shall utilize the LAGEOS simulator, GFE test retroreflectors and mounting hardware and the GFE LAGEOS CCR installation stand. Successful completion of the required training will result in certification, by Bendix Quality Control, of the personnel involved.

TABLE 3-1

Correlation Between Contract SOW and LAGEOS Assembly Operations Plan

Contract SOW Tasks	LAGEOS Assembly Operation Plan Tasks
A	3.7
B	3.1, 3.2, 3.3, 3.5 and 3.6
C	3.1, 3.2, 3.3 and 3.6
D	3.5
E	3.2
F	3.1 and 3.2
G	3.2 and 3.6
H	3.3
I	3.1 and 3.4
J	3.3

3.1.4 Transport the GFE LAGEOS ball, and other accompanying GFE hardware, from the NASA aircraft at Detroit Metro or Willow Run to Bendix.

3.1.5 Receive, inspect for damage and document condition of all GFE flight hardware, tools and handling GSE (as identified in Appendix A) at Bendix.

3.1.6 Design and fabricate the fixtures required to accomplish the LAGEOS sphere assembly cleaning, including vacuum bakeout operations. Perform set-up of the cleaning and vacuum bakeout facilities.

3.1.7 Perform the precision cleaning of LAGEOS flight sphere assembly at Bendix in accordance with the approved procedure. The LAGEOS will be handled, using an approved Bendix handling procedure, with the LAGEOS handling GSE, supplied as GFE. The sphere assembly will have been precision cleaned after fabrication by MSFC, but subsequently exposed to a non-clean test area at MDAC, prior to arriving at Bendix. Cleaning at Bendix is defined as flushing of tapped CCR mounting holes with Freon TF and wiping of cavity surfaces and outside spherical surfaces with Freon TF, followed by a vacuum bakeout, at 125°C for 24 hours, in the Bendix 4' x 4' vacuum chamber. The MSFC LAGEOS lapping fixture will be supplied as GFE for use in the vacuum chamber, if applicable. Control witness samples, including GFE test CCRs, shall be installed with the ball during the vacuum bakeout.

3.1.8 Design and fabricate any tools and shop aids required to accomplish the assembly operations, except GFE items listed in Appendix A.

3.1.9 Install the LAGEOS flight sphere assembly on the LAGEOS CCR installation stand and install the flight retroreflectors in the LAGEOS, using GFE

flight hardware and Bendix-supplied nylon screws (readily identifiable as non-flight). Retroreflectors will not, however, be installed in cavities utilized for LAGEOS handling, for the LAGEOS mounting interface with the shipping container and for the subsequent installation of four germanium retroreflectors. Cavities for the germanium retroreflectors are to be defined by NASA/MSFC. An approved procedure will be used to document each operation. This task is to include set-up and tear down of the work area. The assembly operation shall be accomplished in a class 100,000, or better, clean area. Procure, inspect and clean sufficient nylon screws for CCR and mounting ring installation. Perform a final inspection, including an update review of the ADP, after assembly completion.

3.1.10 Remove the LAGEOS from the CCR installation stand, using GFE handling GSE, and install the LAGEOS in the LAGEOS shipping container, using approved procedures for handling and installation. Transport the LAGEOS shipping container and handling GSE to the NASA aircraft at Detroit Metro or Willow Run Airports for transport to GSFC.

3.2 Test Support at MDAC-W and GSFC.

3.2.1 Provide liaison with MSFC for the planning of the test support at MDAC-W and GSFC. This shall include two coordination and planning meetings at GSFC, prior to the start of the test support.

3.2.2 Provide test support at MDAC-W during the launch vehicle/LAGEOS dynamic and separation tests as follows:

3.2.2.1 Install nine test retroreflectors and mounting rings and two accelerometer mounts in the LAGEOS flight structure at MDAC-W prior to the start of tests. This is to include generation of an appropriate procedure for operation documentation purposes and for procedural checkout at Bendix prior to the activity at MDAC-W. Test hardware is to be that provided as GFE. Remove these test retroreflectors from LAGEOS at Bendix, prior to the cleaning operation (Task 3.1.7).

3.2.2.2 Support the NASA review of the LAGEOS data package and hardware at the turnover meeting for the LAGEOS flight structure at MDAC-W (MDAC-W to MSFC turnover).

3.2.3 Provide test support at GSFC during the LAGEOS optical tests at GSFC as follows:

3.2.3.1 Accompany transport of the LAGEOS shipping container and handling GSE hardware from the airport to GSFC. Inspect the LAGEOS flight satellite and the LAGEOS shipping container on arrival at GSFC. Document the condition of all items.

3.2.3.2 For the purpose of GSFC LAGEOS test support stand checkout, procedure verification, Bendix operator certification and optical test checkout, ship the simulator to GSFC. Inspect the LAGEOS simulator and document its condition at GSFC. Install the LAGEOS simulator on the GSFC LAGEOS test support stand. Remove the simulator from the stand after completion. Repackage the simulator and ship back to Bendix to support final assembly training (Task 3.3.3).

3.2.3.3 Remove the LAGEOS flight satellite from its shipping container, and install it on the GSFC LAGEOS test support stand, using an approved procedure for installation, handling and documentation. Quality control coverage shall be provided for verification of these handling operations.

3.2.3.4 Install retroreflectors in the open cavities, except for those assigned to germanium retroreflectors. The germanium retroreflectors are to be installed at GSFC, if available; otherwise cavities are to remain vacant. Operate the LAGEOS/test support stand assembly, in accordance with the approved procedure and provide one-shift protective monitoring during the GSFC tests, for a period of up to 25 work days.

3.2.3.5 Remove the LAGEOS flight satellite from the test support stand and reinstall in a different mounting orientation, once, during the test period. Perform and document in accordance with the approved procedure. Quality control coverage shall be provided for verification of these handling operations.

3.2.3.6 Remove the LAGEOS from the test support stand and reinstall in the LAGEOS shipping container, using approved procedures for handling, installation and documentation. Retroreflectors will be removed from specific cavities, as required for handling and installing LAGEOS in the shipping container. Quality control coverage shall be provided for verification of these handling operations. Repackage the handling GSE. Inspect the simulator and CCR installation stand after arrival at GSFC. Accompany transport of the LAGEOS and the supporting hardware to the airport from GSFC. Transport from GSFC to WTR is to be by NASA aircraft.

3.3 Satellite Final Assembly

3.3.1 Generate a procedure, in the Bendix standard procedure format, which delineates the steps required to be followed and provides the means for documentation of the satellite final assembly operations at WTR. Release the procedure after NASA review and approval, and revise, as required, after procedure checkout in training exercises.

3.3.2 The training plan for this activity shall be included in the training plan of Task 3.1.2.

3.3.3 Conduct training exercises at Bendix for personnel, including quality control, who may be assigned to the final assembly operations of the LAGEOS at WTR. These exercises shall utilize the LAGEOS simulator, GFE test retroreflectors and mounting hardware and the GFE LAGEOS CCR installation stand and lapping fixture. Successful completion will result in certification, by Quality Control, of the personnel involved. After completion of these training exercises, repackage the simulator, CCR installation stand and lapping fixture and ship to GSFC.

3.3.4 Provide liaison with MSFC for the coordination and planning of this activity at WTR. This task shall include one visit to WTR, prior to the start of the assembly activity.

3.3.5 Accompany transport from airport to WTR. Receive, unpack, inspect for damage and contamination and document the condition of the LAGEOS flight satellite, the simulator and the GFE CCR installation stand, lapping fixture and handling GSE upon arrival at WTR.

3.3.6 Install the LAGEOS on the LAGEOS CCR installation stand and lapping fixture, using approved procedures to document this activity.

Clean or replace any contaminated or damaged hardware, as required, up to a maximum of 50 items. Spares shall be provided as GFE. Install the CCR flight mounting screws (GFE), the satellite flight nuts and equator fittings and the CCR's in the open cavities, including the germanium CCRs. Quality Control coverage shall be provided for critical handling and installation operations, including documentation of torque values of all final installation items with quality control verification.

3.3.7 Support the flight hardware turnover review at WTR. This shall include a visual inspection of the LAGEOS and a review of the acceptance data package and supporting documentation.

3.3.8 Repackage all GFE GSE, the simulator and the LAGEOS shipping container for shipment to MSFC and Bendix, respectively. Shipment is to be by NASA aircraft. Transport containers from Detroit Metro or Willow Run to Bendix.

3.4 LAGEOS Simulator

3.4.1 Design, fabricate and assemble a full-scale LAGEOS simulator which meets envelope and handling interface requirements. This simulator is intended for use in satellite assembly training and for the fit-check and operational checkout of the GSFC LAGEOS test support stand and the LAGEOS shipping container. Quality Control inspection shall be limited to the final assembly inspection of critical dimensions.

3.4.2 Conduct a stress analysis of critical portions of the simulator to ensure structural integrity during its intended use.

3.4.3 Fabricate and assemble a set of handling GSE for training use, based on the MSFC handling GSE design.

3.4.4 Conduct a fit-check of the simulator on the LAGEOS CCR installation stand. The procedure of task 3.6.3 shall be used to document this action. Provide the simulator for use in tasks 3.1, 3.5 and 3.6.

3.4.5 After use of the simulator in tasks 3.1, 3.5 and 3.6 at Bendix, package the simulator for transport to GSFC.

3.5 LAGEOS Shipping Container

3.5.1 Design, fabricate and assemble modifications in an ALSEP shipping container to provide for shipment of a fully-assembled LAGEOS in the container, except as required for handling and installation. The ALSEP shipping container shall be transferred to LAGEOS from the Bendix ALSEP program. Quality Control inspection shall be limited to the final assembly inspection and verification, using the simulator.

3.5.2 Conduct a stress and dynamic analysis of critical portions of the modified shipping container to ensure its structural integrity during the intended use (i.e., truck and aircraft transport). Transportation environment criteria shall be that appropriate for truck and aircraft transport and will be defined in the analysis report.

3.5.3 Generate a procedure for installation of the LAGEOS in, and removal from, the shipping container. The procedure shall be in Bendix

standard procedure format and shall delineate the steps required and provide the means for documenting the installation, and removal. This procedure shall also have provisions for documenting the identification and resolution of hardware and procedural discrepancies. Release the procedure, after NASA review and approval, and revise, as required, after procedure checkout during the fit-check subtask.

3.5.4 Conduct a hardware operational fit-check and a procedure check-out for the installation of the LAGEOS in the shipping container, using the LAGEOS simulator. Use the installation procedure (task 3.5.3) to document this activity. Quality control will monitor these activities.

3.5.5 Provide the container to the accomplishment of task 3.1.8. Direct the first installation of the LAGEOS in the shipping container, using the released procedure to document this activity and identify any hardware or procedural discrepancies. Quality Control will monitor this activity.

3.5.6 Refurbish the shipping container back to the original ALSEP configuration, after its return from WTR; reinstall the ALSEP hardware, if required. This shall include a receiving inspection of the container upon its return from WTR.

3.6 LAGEOS Support Stands

3.6.1 Review the GSFC design of the test support stand for use in the optical tests at GSFC. The stand design mods will be generated by GSFC and will provide support for the LAGEOS at its polar attachment points and its equator attachment points and permit rotation of the LAGEOS about these attachment points for retroreflector installation at GSFC. It will also provide

motor-operated rotation of the LAGEOS about these attachment points, at a rotational speed of about 1 rpm, for optical tests at GSFC. The design data for the stand will be provided to Bendix. The CCR installation stand, a separate stand, shall be provided as GFE to Bendix for use in the LAGEOS cleaning and initial assembly at Bendix. Receive, inspect for damage and document condition of the CCR installation stand at Bendix.

3.6.2 Conduct a stress analysis of the polar and equator attachment points of the LAGEOS flight design to ensure their structural integrity when used to support the LAGEOS on the test support stand in either of two configurations (polar axis or equatorial axis) and with rotation of about 1 rpm.

3.6.3 Generate a procedure for installation of the LAGEOS on, and removal from, the CCR installation stand and for operation of the CCR installation stand during LAGEOS cleaning and assembly operations at Bendix and WTR. The procedure shall be in Bendix standard procedure format and shall delineate the steps required and provide the means for documenting the accomplishment of the installation, removal and operation. The procedure shall also have provisions for documenting the identification and resolution of hardware and procedural discrepancies. Release the procedure, after NASA review and approval, and revise, as required, after procedure checkout during the fit-check subtask.

Generate a procedure for the installation of the LAGEOS on, and removal from, the GSFC test support stand and for operation of the test

support stand to rotate the LAGEOS for optical tests at GSFC. The procedure shall be in Bendix standard procedure format and shall delineate the steps required and provide the means for documenting the accomplishment of the installation, removal and operation. The procedure shall also have provisions for documenting the identification and resolution of hardware and procedural discrepancies. Release the procedure, after NASA review and approval, and revise, as required, after procedure checkout during the fit-check subtask.

3.6.4 Conduct a hardware operational fit-check and a procedure check-out for the installation of the LAGEOS on the CCR installation stand, using the LAGEOS simulator. Use the installation procedure (task 3.6.3) to document this activity. Quality Control will monitor this activity.

Conduct a hardware operational fit-check and a procedure check-out for the installation of the LAGEOS in the GSFC test support stand at GSFC, using the LAGEOS simulator. Use the installation procedure (task 3.6.3) to document this activity. Quality Control will monitor this activity.

3.6.5 Conduct training exercises at Bendix in the operation of the LAGEOS in the CCR installation stand for personnel who will be required to perform this function at Bendix and WTR. The LAGEOS simulator shall be used for these exercises. The training plan for this activity shall be included in the training plan of task 3.1.2. Successful completion will result in certification of the personnel involved, by Quality Control.

Conduct training exercises at GSFC in the operation of the LAGEOS in the test support stand for personnel who will be required to perform this

function at GSFC. The LAGEOS simulator shall be used for these exercises. The training plan for this activity shall be included in the training plan of task 3.1.2. Successful completion will result in certification of the personnel involved, by Bendix Quality Control.

3.6.6 Provide the CCR installation stand to the LAGEOS assembly tasks, 3.1 and 3.3. Direct the first installation of the LAGEOS on the test support stand, using the released procedure to document this activity and identify any hardware and procedural discrepancies. Quality Control will monitor this activity.

Direct the first installation of the LAGEOS on the GSFC test support stand at GSFC, using the released procedure to document this activity and identify any hardware and procedural discrepancies. Quality Control will monitor this activity.

3.6.7 Package the CCR installation stand for transport to GSFC.

3.7 Project Management

Perform the project management required to provide continuity and direction of the assembly operation tasks. This shall include responsibility for single-point-of-contact for the MSFC project management, as well as providing liaison with MSFC, GSFC, MDAC and WTR, as required to accomplish these operation tasks. This task shall include the submittal of contract documentation, consisting of the Assembly Operation Plan, Procedures, Analyses, Drawings and Monthly Reports.

Coordinate the packaging and shipment to MSFC of all GFE, contract residual hardware and deliverable items, after completion of the final assembly operations.

4. OPERATION FLOW DIAGRAMS

The operation flow diagrams for the LAGEOS assembly operations are structured around the six basic tasks. The interrelation of these basic tasks is shown in Figure 4-1. The basic tasks have been organized into subtasks which identify the detailed activities to be performed. The interrelationships and sequence of these subtasks are shown in Figures 4-2 thru 4-6.

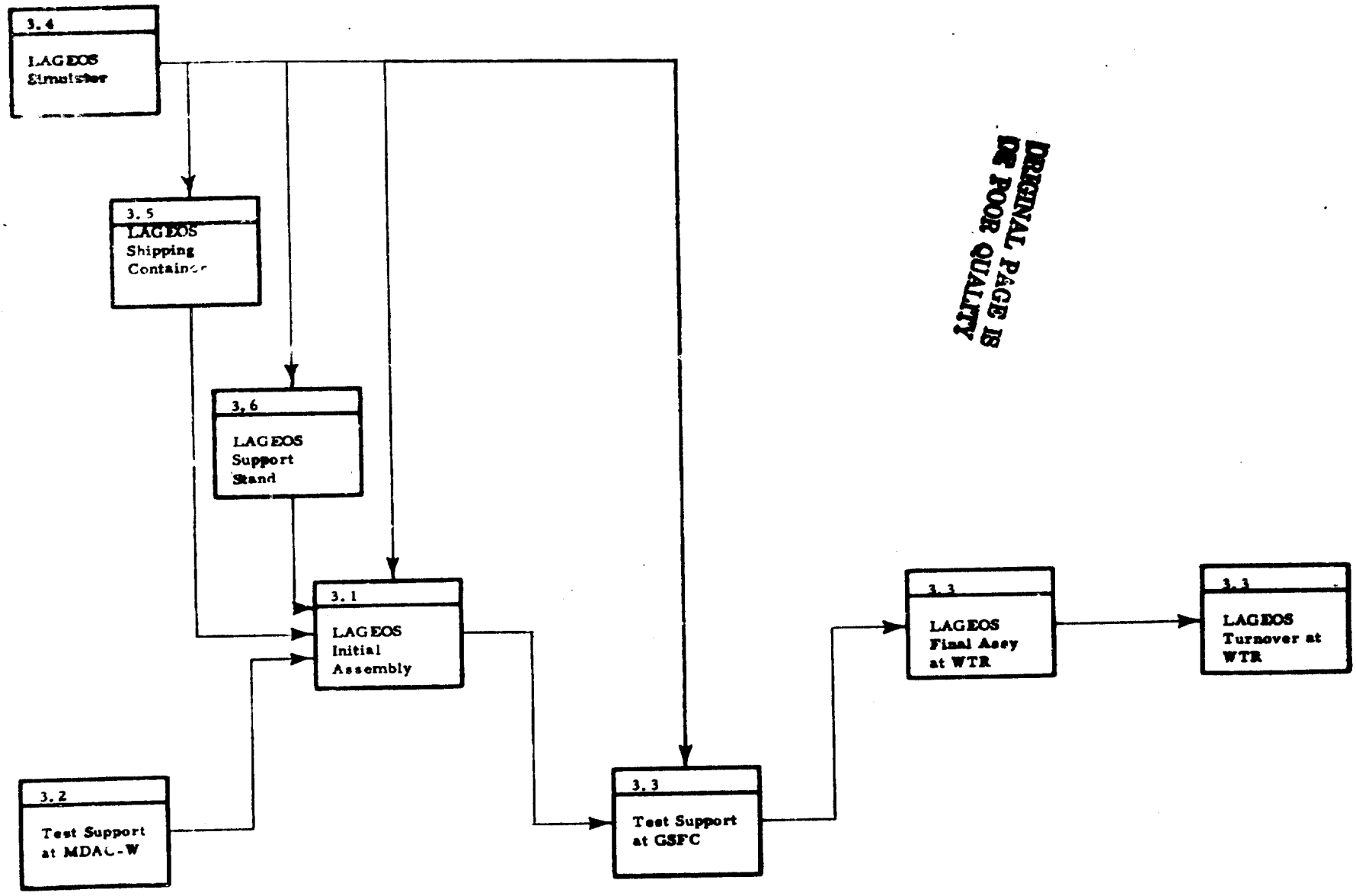


Figure 4-1 - Assembly Operation Task Flow Summary

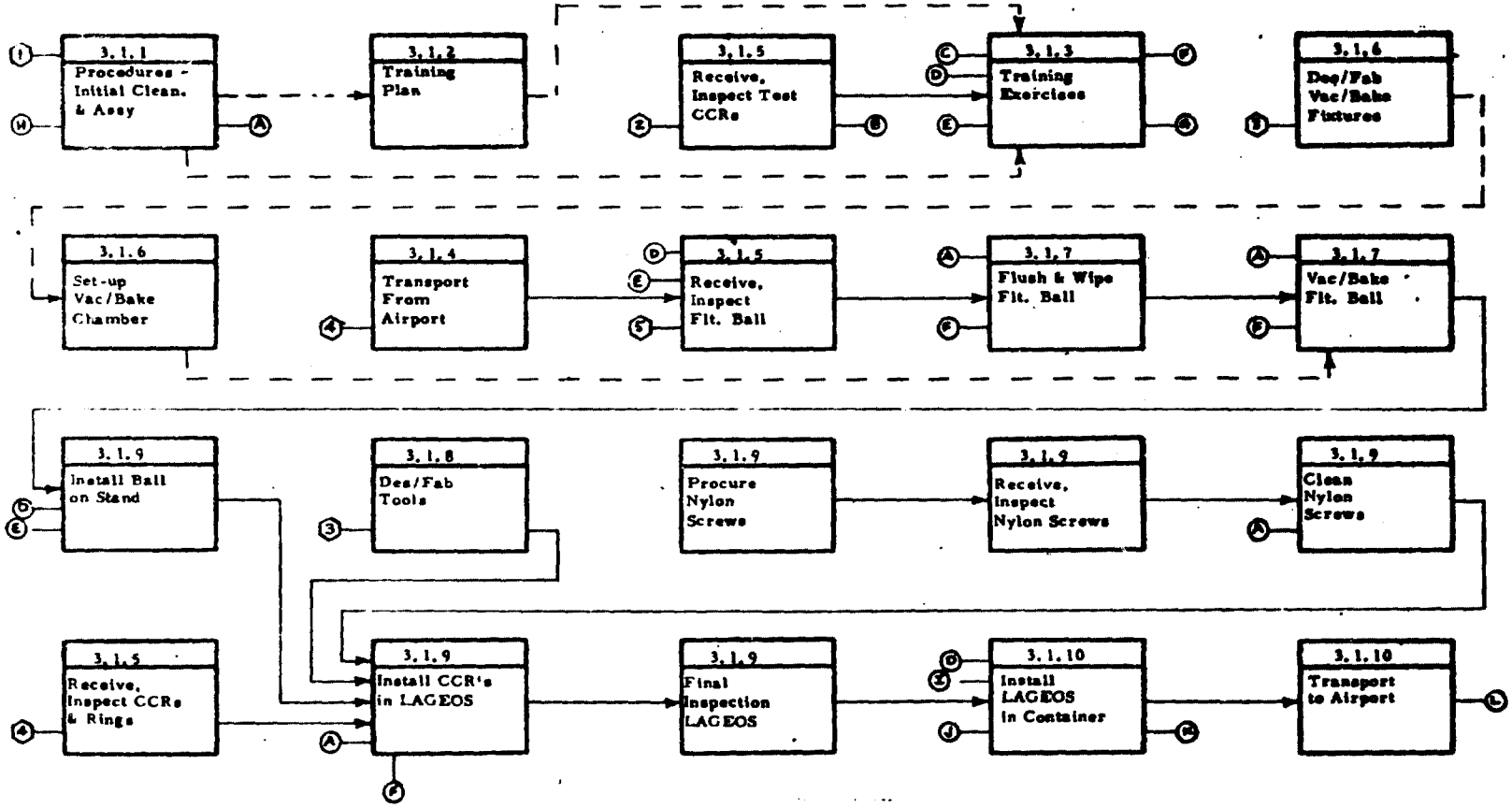


Figure 4-2 - Task 3.1-Satellite Initial Assembly

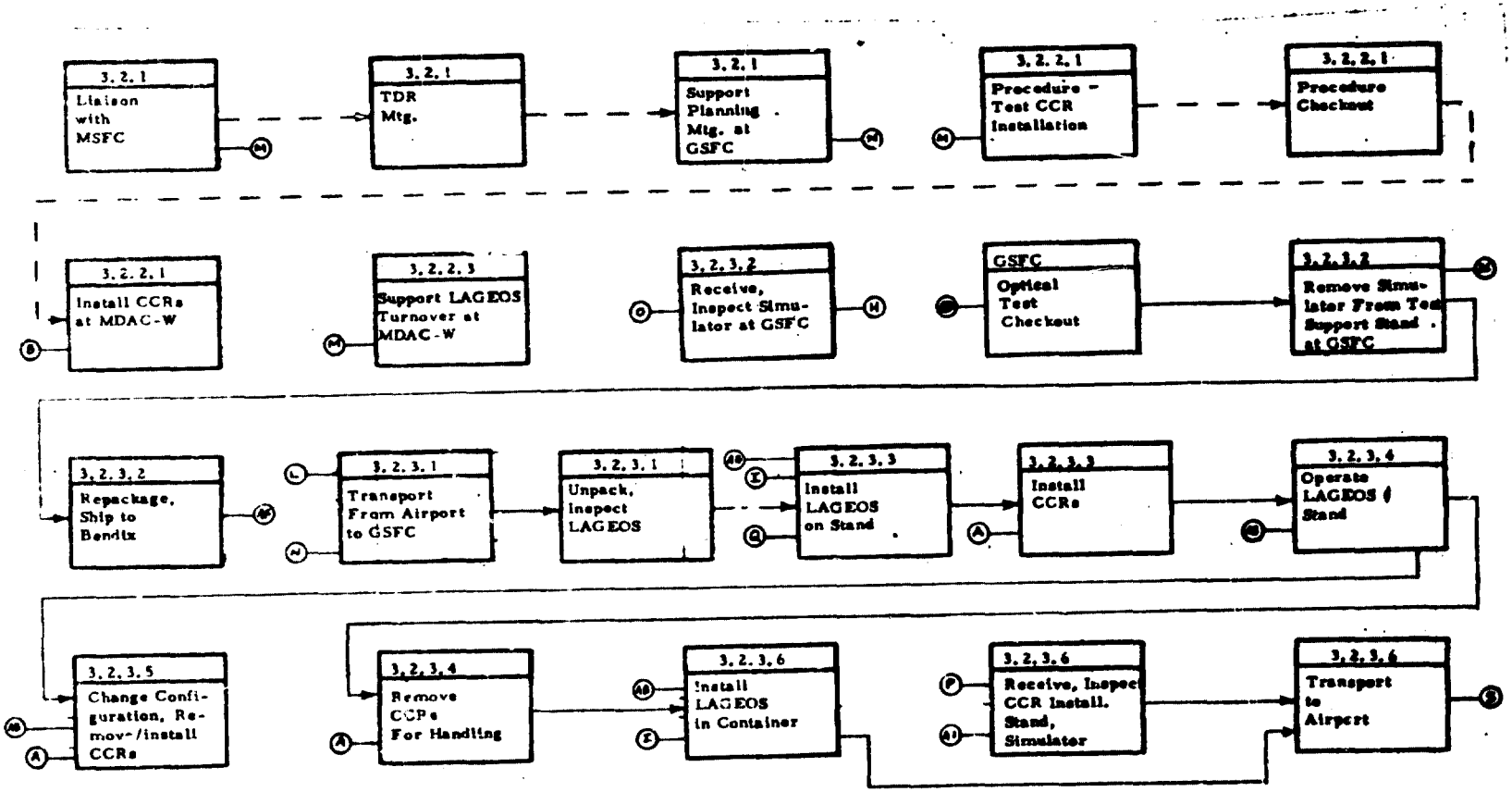


Figure 4-3 - Task 3.2-Test Support at MDAC-W and GSFC

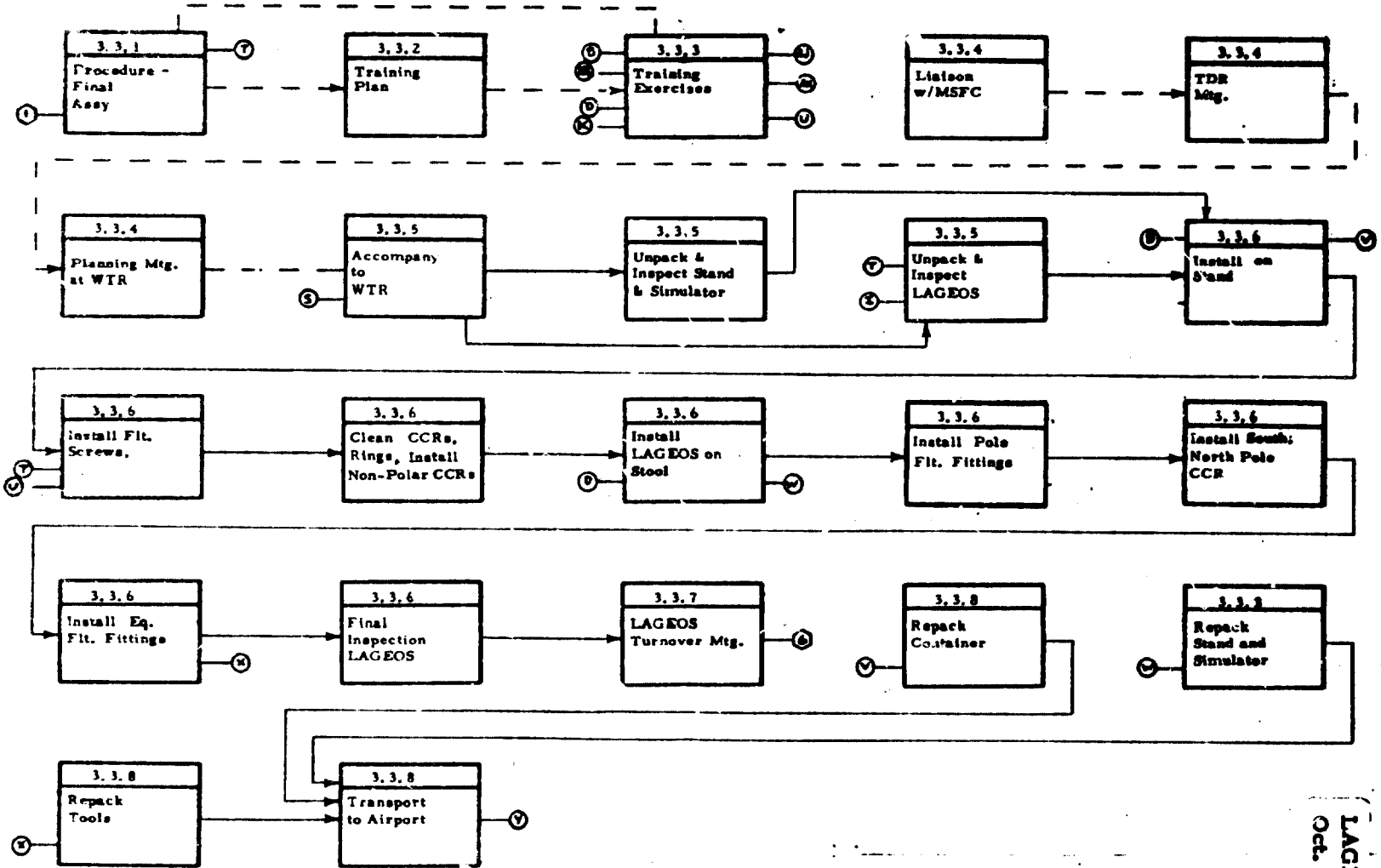


Figure 4-4 - Task 3.3-Satellite Final Assembly

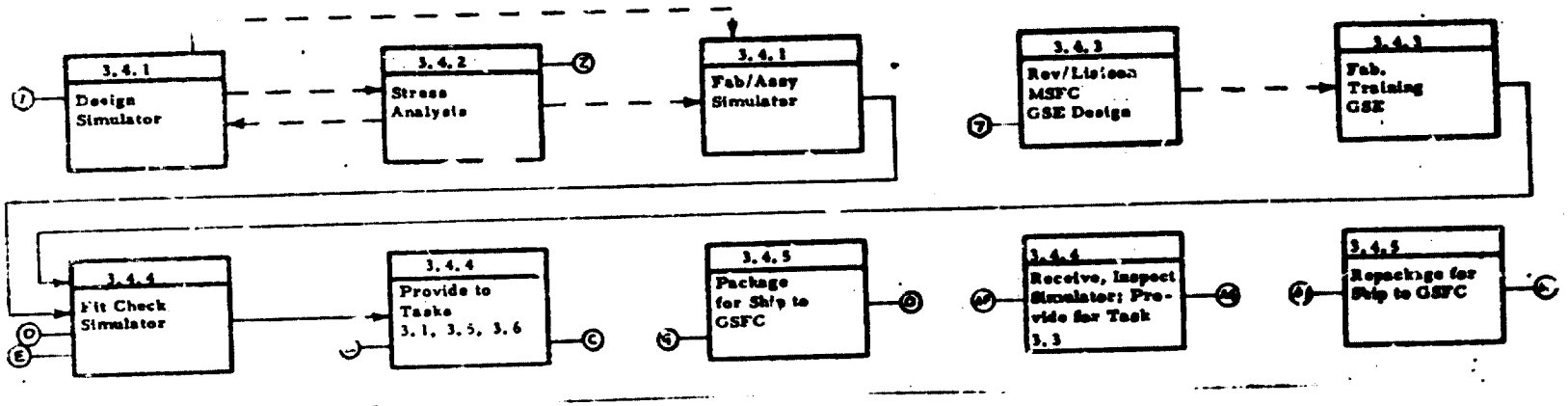


Figure 4-5A - Task 3.4-LAGEOS Simulator

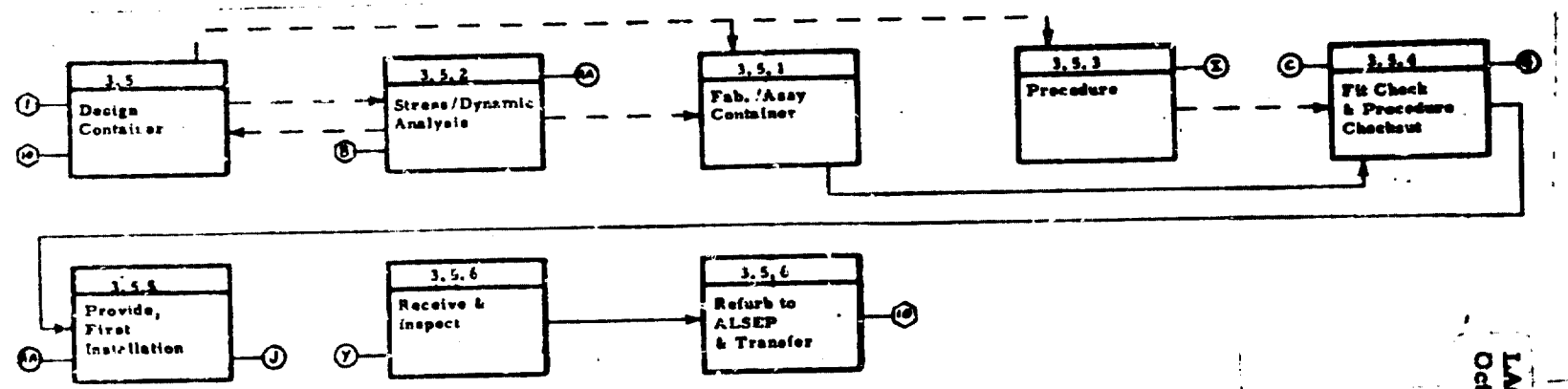
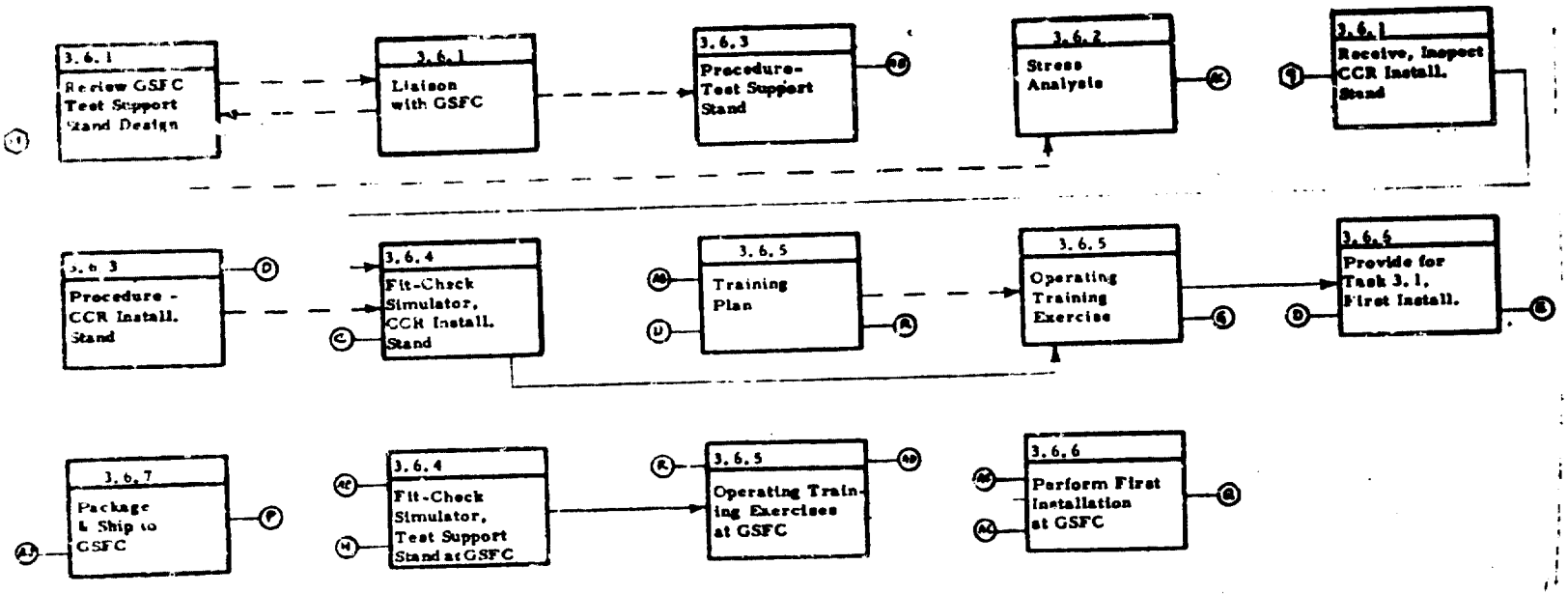


Figure 4-5B - Task 3.5-LAGEOS Shipping Container



NASA/MSC Interface Code

Code	Function
1	LAGEOS Design Data
2	LAGEOS Test Hardware (GFE)
3	LAGEOS Assy. Tools (GFE)
4	LAGEOS Flight Hardware (GFE)
5	LAGEOS Handling GSE (GFE)
6	LAGEOS Turnover to MSFC/MDAC-W
7	LAGEOS Handling GSE Design Data
8	Transportation Environment Criteria
9	LAGEOS CCR Installation Stand from GSFC (GFE)
10	ALSEP Container Transfer Approval
11	LAGEOS Test Support Stand Design Data from GSFC

Figure 4-6 - Task 3.6-LAGEOS Support Stands

5. OPERATION SCHEDULE

The schedule for the operation tasks and subtasks is shown in Figures 5-1A and 5-1B. It includes dates of various coordination and review meetings for planning purposes and dates for submittal of required documentation.

The schedule is based on a 23 June 1975 start date and provides for the accomplishment of the various subtasks to meet the contract schedule constraints, as defined in Appendix A.

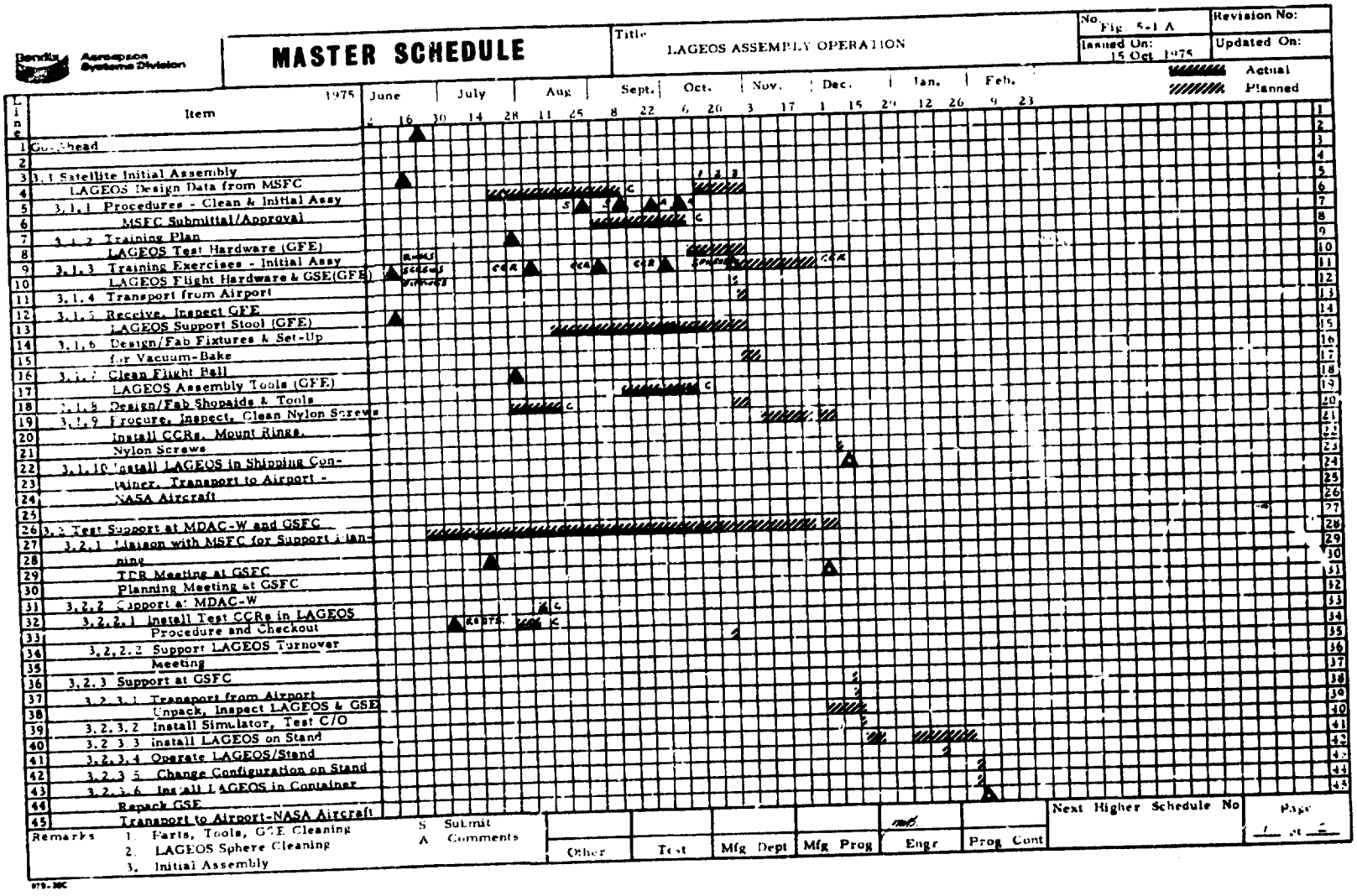


Figure 5-1A - Master Schedule-LAGEOS Assembly Operation

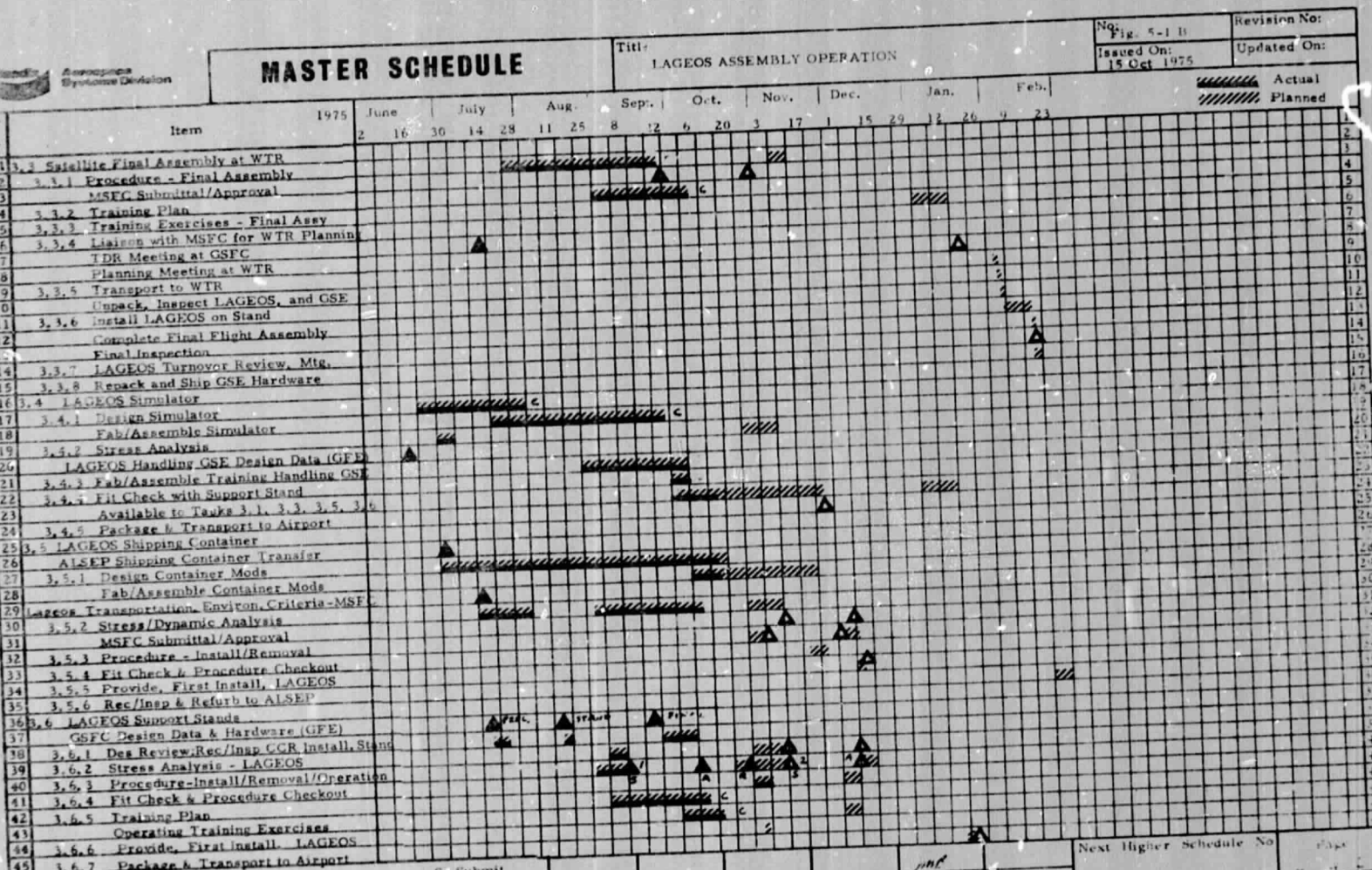


Figure 5-1B - Master Schedule-LAGEOS Assembly Operation (Continued)

6. QUALITY ASSURANCE

Quality Assurance will be implemented by Bendix throughout the performance of the LAGEOS Assembly Operation. Specific Quality Assurance functions are described in this section.

6.1 Quality Engineering

A Quality Assurance (QA) Department Engineer will be assigned the responsibility for QA on the LAGEOS program to provide a single-point contact. Quality engineering functions will include program liaison and coordination, QA support scheduling, review/approval of operations/test plans and procedures, review of training plans, preparation of lesson plans and conducting of training exercises, certification of personnel for LAGEOS special operations, preparation of inspection criteria, preparation and maintainance of the flight article logbook, and participation in the LAGEOS QRB.

6.2 Receiving Inspection

It is assumed that all GFE will have been inspected by MSFC and conforms to drawing and/or specification, prior to shipment to Bendix. Accordingly, receiving inspection will be limited to verification of the receipt of all shipped items and visual inspection for shipping damage.

Receiving inspection, by Bendix, at GSFC and WTR will also be limited to a visual inspection to verify that no shipping damage has been incurred.

6.3 In-Process Inspection

Inspection of the shipping container modifications, and LAGEOS

simulator fabrication and assembly will be performed only at the top assembly level and will include verification of critical dimensions and interfaces. Fit checks will be performed, as defined in the detail tasks of Section 3.0.

In-process inspection of the satellite assembly operations will be on a full-coverage basis. Operations to be witnessed include flight hardware cleaning, installation of CCR's and mount rings, installation of flight fittings and screws at WTR, flight hardware handling and installation on, and removal from, the CCR installation stand and the test support stand, and flight hardware packaging for shipment.

6.4 Final Inspection

Final inspection of the LAGEOS satellite will be performed at BASD following the assembly operation before shipment to GSFC, at GSFC before shipment to WTR, and at WTR prior to turnover of the satellite. This final inspection will include a thorough visual examination of the satellite, review and verification of the hardware configuration, and review of the satellite logbook.

6.5 LAGEOS Satellite Logbook

Bendix QA will review the flight satellite logbook, maintained by MSFC up to the time of turnover to BASD. Turnover of the flight article includes acceptance of the logbook. A follow-on logbook will be initiated, in the BASD format, to include all work performed by Bendix on the flight article.

The follow-on logbook will include the following sections:

1. **Operating Events Log (OEL)**
2. **Open Items**
3. **Flight Article Configuration Summary**
4. **Operations/Test Procedures**
5. **Data Sheets**
6. **Nonconformances**

All logbook entries will be signed and/or stamped and dated.

6.6 Nonconformances

6.6.1 Definitions

A deficiency is a nonconformance which will have no effect on the final flight article assembly.

A discrepancy is a nonconformance which can, or will, affect the final flight article assembly. Any nonconformance of GFE is defined as a discrepancy.

6.6.2 Deficiencies

Deficiencies will be corrected by rework, repair, replacement or recycle methods and will be documented by variations incorporated in the "as-run" operations/test procedure. Variations will require BASD Project Manager and QA approval before implementation.

6.6.3 Discrepancies

Discrepancies will be documented on the BASD Discrepancy Report (DR) format. Review and disposition of discrepancies will be by BASD Quality Review Board (QRB) action. All discrepancies identified as "major" by the QRB will be reported to MSFC before impiemention of the disposition.

DR's will be processed in accordance with the methods set forth in BASD Quality Assurance Procedure #12 and BASD Quality Assurance Instruction #12-1.

6.7 Operator Training/Certification

Quality Assurance will prepare lesson plans and conduct training exercises for the LAGEOS special operations. Trained operators will be issued a certificate of proficiency. Special operations will include installation/removal/handling of CCR's and installation/handling of the LAGEOS with GSE, the CCR installation stand, the test support stand and the shipping container.

7. DOCUMENTATION SUBMITTAL

The documentation to be submitted during this operation activity shall be as specified in the Data Procurement Document No. 296 (NASA Contract NAS8-30656), as modified by this contract change. Specifically, they will be:

.	MA-02	Report, Letter Progress and Status (submitted monthly)
.	MA-05	LAGEOS Assembly Operation Plan (updated after negotiation and revised as required by contractor or government requested changes)
.	SE-01	Engineering Drawings (submitted as released or revised)
.	SE-02	Stress Analysis (submitted as completed)
.	RA-01	LAGEOS Handling, Cleaning and Installation Procedures (submitted 45 days prior to a planned operation and final as released; "as-run" procedures will be incorporated in the satellite acceptance data package)
.	———	Training Plan (for review only) (transmitted as completed)

8. REFERENCE

The documents referenced in the plan are:

. Exhibit B, Scope of Work - Assembly Operation for the Laser Geodynamic Satellite (LAGEOS) of Contract Amendment 5A11, DCN 1-4-21-00261 S5 (1F) and 1-5-31-00376 S2 (1F), NAS8-30658 dated May 14, 1975.

APPENDIX A

GUIDELINES AND CONSTRAINTS

A. The physical characteristics of the satellite structure, CCR mounts and retaining rings shall be as defined in the Contract End Item (CEI) Specifications SAT-1 and CCR-1.

B. The equipment listed in Table A-1, will be provided as GFE (Government Furnished Equipment) and will be available on or before the dates indicated.

C. The satellite will be handled in accordance with the guidelines as outlined in MMI 6400.2A Packaging, Handling and Moving of Program Critical Hardware. Only certified operators and equipment will be utilized to handle the satellite and associated equipment.

D. A Test Support Equipment Design Review (TDR) will be conducted no later than July 30, 1975. Bendix will participate in this review and provide inputs for required support at GSFC and WTR.

E. Configuration Management of the satellite assembly, GSE and approved documentation shall be maintained in accordance with LAGEOS Configuration Management Manual #LA-CM-2.

F. Clean areas in accordance with class 100,000 will be made available at GSFC and the WTR.

G. Acceptance of assembled satellite will be by visual inspections, review of engineering documentation and quality records in the Satellite Acceptance Data Package.

H. Shipment of the satellite will be by Government air. Transportation to and from airfields will be Government furnished except for shipments at the Bendix facility.

I. Schedule constraints are outlined below. The assembled satellite and associated GSE are to be completed and ready for shipment to GSFC on December 11, 1975. Test at GSFC is to be completed January 29, 1976. Satellite and GSE to be packaged and ready for shipment to WTR on February 3, 1976. Satellite flight fittings, screws, etc. are to be installed and the satellite, ready for transfer to MDAC-W for separation system mating on February 19, 1976.

TABLE A-1

Item No.	Description	Part Number	Quantity	Delivery Date
1.	LAGEOS Sphere Assembly	30M20458C	1 each	10/28/75
2.	CCR Installation Stand	30M20485	1 each	8/14/75
3.	Lifting Eye	30M20466	2 each	10/28/75
4.	Handling Beam Assembly	30M20467	1 each	10/28/75
5.	LAGEOS Shipping Container	30M20471	1 each	10/28/75
6.	CCR Guide Pin	30M20472	10 each	7/29/75
7.	Handling Ring Assembly (incorporated with item No. 2) -			8/14/75
8.	Material Finish Specimen	30M20478	1 each	10/28/75
9.	Retainer	50M23170	440 each	6/11/75
10.	CCR	50M24431	440 each	*
11.	Ring Mount, Upper	50M25552	440 each	6/11/75
12.	Ring Mount, Lower	50M25553	440 each	6/11/75
13.	Screws	MS35202-8	2100 each	6/11/75
14.	CCR Installation Tool Set		2 each	7/29/75
15.	CCR Transfer Tray w/Lids	EC-32-CCR-1,2	1,10 each	7/29/75
16.	Support Table	30M20486	1 each	10/28/75
17.	Deleted			
18.	Data Package (with item No. 1)	No P/N	1 each	10/28/75
19.	Test CCR	No P/N	10 each	7/29/75
20.	Test Retainer	2374463 50M23170	6 each 12 each	7/29/75 10/28/75

*100 ea by 10/28/75, 100 ea per week, final by 11/30/75

Item No.	Description	Part Number	Quantity	Delivery Date
21.	Test Ring Mount, Upper	2374461 50M25552	6 each 12 each	7/29/75 10/28/75
22.	Test Ring Mount, Lower	2374462 50M25553	6 each 12 each	7/29/75 10/23/75
23.	Lapping Fixture	30M20484	1 each	6/11/75
24.	CCR Dummy	30M20479	2 each	10/28/75
25.	Accelerometer Mounts	3020473	4 each	10/28/75
26.	Accelerometer Clips	3020474	4 each	10/28/75
27.	Accelerometer Block	30M20480	2 each	10/28/75
28.	Load Test Bar	30M20483	1 each	10/28/75
29.	Accelerometer	ENVECO-2222	5 each	10/28/75
30.	Nut - self locking nuts	30M20481	2 each	6/11/75
31.	Washer	30M20482	2 each	6/11/75
32.	Fitting	30M02462	12 each	10/28/75
33.	Test Article	2374464	1 each	7/29/75
34.	Screws, Test	MS35202-8	18 each	7/29/75
35.	Support Fitting, Becu (for simulator use only)	30M20462	2 each	8/18/75
36.	Nut, Cad. Plated Steel (for simulator use only)	42FW-1216	2 each	8/18/75
37.	Drill Guide	No P/N	1 each	9/4/75
38.	Tap Guide	No P/N	1 each	9/4/75
39.	Cable Assy	No P/N	1 each	9/4/75
40.	Trunnions	30M20477	2 each	10/28/75